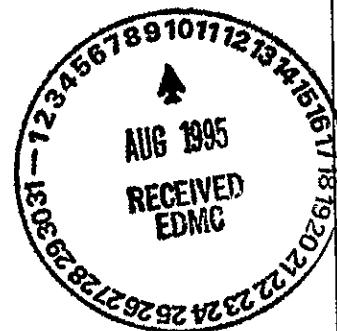START

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Title of Document: 200-ZP-1 Groundwater Sampling Analysis/Project

Quality Assurance Plan

Authors: _B. H. Ford_   8/9/94

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Approval: D. L. Parker   ITC/EEN

(Printed name and organization of responsible manager)

_____   8/9/94

(Signed name of responsible manager)   Date

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1.0 INTRODUCTION

Groundwater sampling and analysis in support of the 200-ZP-1 operable unit interim remedial measure (IRM) will be conducted in discrete phases to support activity-specific data quality objectives (DQO). The phasing of sampling activities, which are being addressed, is a reflection of IRM investigations, treatment activities, remedial actions, or compliance issues. No single, static monitoring network can meet all the data needs of each of the discrete activities that make up the entire operable unit investigation/remediation. Therefore, this sampling and analysis plan (SAP) provides the rationale for the development of four monitoring network designs, the DQOs associated with each design, the specifics for each network (i.e., wells, sampling schedules, and parameters), and supporting work that influences future network modifications.

1.1 MONITORING NETWORK RATIONALE

Four categories of wells have been identified that will accommodate the monitoring objectives of the IRM. These four categories are:

- Treatability test monitoring wells
- Remedial action assessment wells
- Plume periphery monitoring wells
- Point of compliance monitoring wells.

Each of these networks is designed to address general and specific DQOs, which are summarized below. The well networks are nested one within the other from the center of highest concentration of carbon tetrachloride (treatability test and remedial action assessment wells) to lower concentration (plumes periphery wells) to areas of no contamination (point of compliance wells). These categories do not represent static set of wells. Monitoring wells selected for each category may change over the course of the IRM to reflect treatment or remedial action activities. The networks that will change the most are the two networks closest to the centers of highest contaminant concentration.

1.2 MONITORING NETWORK GENERAL OBJECTIVES

The general objectives of each monitoring category are summarized in Table 1.

Table 1. Summary of Construction Information for Monitoring Wells
in the Treatability Test Monitoring Network.

Category	General objectives
Treatability test monitoring wells	1. Decide the effects of groundwater extraction and injection on volatile organic constituents (VOC), co-contaminants, and geochemical parameters in the area of influence of the test. 2. Monitor hydraulic impacts in the area of influence of the test. 3. Refine contaminant and co-contaminant concentration information. 4. Provide data that can be used to enhance operation of the remedial system.
Remedial action assessment wells	1. Provide baseline information on VOC, co-contaminant, and geochemical parameters in high concentration areas of the carbon tetrachloride plume. 2. Monitor the impacts of remediation on contaminant concentrations and geochemical parameters in high mass areas of the carbon tetrachloride plume. 3. Monitor hydraulic impacts of remediation. 4. Provide data to assist in interim remedial measures.
Plume periphery monitoring wells	1. Monitor the movement of VOC contamination out of the 200 West Area.
Point of compliance monitoring wells	1. Monitor for the exceedance of VOC regulatory limits at the "point" of compliance.

1.3 DATA QUALITY OBJECTIVES

The DQOs are qualitative and quantitative statements that specify the quality of data required to support decisions and are determined based on the end uses (or objectives) of the data to be collected. Each category of monitoring wells has its own set of end users as

outlined in Table 1. Expected users of the test data include: (1) U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) remedial project managers, and (2) Westinghouse Hanford Company (WHC) remedial investigation coordinators and support teams.

To ensure that data collected for each category of monitoring wells are of sufficient quality to evaluate the end uses of the data, category-specific DQOs have been developed. The importance and ramification of the decisions to be made for each category of wells forms the basis for defining the DQOs.

Analyses to be conducted for each well category include a combination of lower level (Levels I and II) and higher level (Levels III, IV, and V) data sets to obtain the needed information in a cost-effective manner. Field screening and field analysis techniques (Levels I and II) will be used for less critical, quick-turnaround determinations (e.g., during treatability testing). More limited use will be made of higher level analyses, primarily as confirmatory samples or for evaluating regulatory standard compliance. Specific DQOs for the individual well network categories are developed in Tables 1 through 5.

2.0 GROUNDWATER MONITORING

Details of the field programs for the four monitoring networks that support the 200-ZP-1 IRM are discussed in this section. Work controlling health and safety requirements are specified.

2.1 REQUIREMENTS

In addition to other requirements identified in this document, all work will be performed in accordance with the following applicable documents and procedures:

- *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990)

Table 2. Data Quality Objectives for Treatability Test Monitoring Wells.

Activity: Groundwater monitoring during treatability test activities.

Objectives: Assess the effects of groundwater extraction and injection on VOC, co-contaminants, geochemical parameters, and hydraulic impacts in the area of influence of the test.

Refine contaminant and co-contaminant concentration information.

Prioritized Data Uses: To support treatability test feed water requirements and to provide input parameters for numeric model calibration and remedial action design.

Parameters to be Obtained:

Hydrochemical

- Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) and interfering non-target groundwater constituents (anions) before, during, and after treatment testing
- General groundwater quality parameters to include gross alpha, gross beta, tritium, pH, temperature conductivity, and oxidation-reduction potential (ORP).
- Tracer concentrations necessary in hydraulic parameter testing.

Hydraulic

- Water levels in wells expected to be affected by the zone of influence of either the extraction or injection well.
- Effective porosity (if possible).
- Hydraulic conductivity (if possible).
- Storativity (if possible).
- Transmissivity (if possible).

Appropriate Analytical Level or Implementation Guidelines: Primary contaminants will be determined by field screening (Level II) with offsite laboratory verification (Level IV) at a minimum of one in every 20 well trips. All other parameters will be measured using field methodologies (Level II).

Required Detection or Measurement Limits

Parameter	Method	RDL[b] (ppb)	Precision	Accuracy
carbon tetrachloride	GC[a]	5	$\pm 10\%$	$\pm 10\%$
chloroform	GC	5	$\pm 10\%$	$\pm 10\%$
trichloroethylene	GC	5	$\pm 10\%$	$\pm 10\%$

[a]GC = gas chromatography
[b]Required detection limit

Critical Samples or Values: Primary contaminants should be measured throughout the testing, especially during varying pumping regimes, to evaluate contaminant response under varying extraction regimes.

Constraints:

- Representative groundwater samples are required.
- Tracer testing should be conducted during steady-state pumping, preferably near the beginning of the treatment tests.

Table 3. Data Quality Objectives for Remedial
Action Assessment Monitoring Wells.

Activity: Groundwater monitoring during remedial action activities.

Objectives: To provide remedial design input information by:

- Baselining the primary contaminants, co-contaminants, and general groundwater parameters-of-interest in high contaminant concentration areas,
- Monitoring the impacts of remediation activities on primary contaminants, co-contaminants, and general groundwater parameters-of-interest in high contaminant concentration areas, and
- Monitoring hydraulic impacts of remediation.

Prioritized Data Uses: Support the remedial design process by establishing baseline concentration and hydraulic parameter information and to detect changes in baseline conditions that reflect the effects of remedial action activities.

Parameters to be Obtained:

Hydrochemical

- Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) and potential interfering non-target groundwater constituents.
- General groundwater quality parameters to include gross alpha, gross beta, tritium, pH, temperature, conductivity, and ORP.

Hydraulic

- Baseline water levels in wells in the area of high contaminant concentration and water levels in wells expected to be affected by zones of influence of remedial actions.
- Velocity flowmeter measurements in select wells near extraction wells.

Appropriate Analytical Level or Implementation Guidelines: Primary contaminants will be determined by offsite laboratory analysis (Level IV). All other parameters will be measured in the field or onsite laboratory (Level II) as appropriate.

Required Detection or Measurement Limits

Parameter	Method	RDL[a] (ppb)	Precision	Accuracy
carbon tetrachloride	RCRA 8240	5	±10%	±10%
chloroform	RCRA 8240	5	±10%	±10%
trichloroethylene	RCRA 8240	5	±10%	±10%

[a]Required detection limit

Critical Samples or Values: When concentration changes are noted, or if a well falls within a predicted zone of influence of an extraction well, the frequency of sampling should be increased.

Velocity flowmeter measurements should be considered in select wells that fall within a predicted zone of influence of an extraction well.

Constraints: Representative groundwater samples are required.

Table 4. Data Quality Objectives for Plume
Periphery Monitoring Wells.

Activity: Monitoring of groundwater wells along the periphery of the primary VOC contaminants.

Objectives: Monitor the movement of VOC contamination from areas of highest concentration out of the 200 West Area.

Prioritized Data Uses: Detection and trending of the movement of VOC from areas of highest concentration to provide early warning of movement trends.

Parameters to be Obtained:

Hydrochemical

● Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene).

Appropriate Analytical Level or Implementation Guidelines: Primary contaminants will be determined by offsite laboratory analysis (Level IV). Water levels will be measured in the field (Level II).

Required Detection or Measurement Limits

Parameter	Method	RDL[a] (ppb)	Precision	Accuracy
carbon tetrachloride	RCRA 8240	5	±10%	±10%
chloroform	RCRA 8240	5	±10%	±10%
trichloroethylene	RCRA 8240	5	±10%	±10%

[a]Required detection limit

Critical Samples or Values: When significant concentration changes are noted in a monitoring well the sampling frequency for that well should be increased.

Constraints: Representative groundwater samples are required.

Table 5. Data Quality Objectives for Point of
Compliance Monitoring Wells.

Activity: Monitoring of groundwater wells at "point" of compliance for primary VOC contaminants.

Objectives: Monitor for exceedance of VOC standards.

Prioritized Data Uses: Evaluation of VOC concentration data to detect regulatory standard exceedances that would initiate compliance actions.

Parameters to be Obtained:

Hydrochemical

- Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene).

Appropriate Analytical Level or Implementation Guidelines: Primary contaminants will be determined by offsite laboratory analysis (Level IV).

Required Detection or Measurement Limits

Parameter	Method	RDL[a] (ppb)	Precision	Accuracy
carbon tetrachloride	RCRA 8240	5	±10%	±10%
chloroform	RCRA 8240	5	±10%	±10%
trichloroethylene	RCRA 8240	5	±10%	±10%

[a]Required detection limit

Critical Samples or Values: When significant concentration changes are noted in a monitoring well the sampling frequency for the well may be increased.

Constraints: Representative groundwater samples are required.

- *Environmental Investigations and Site Characterization Manual* (environmental investigation instructions (EII) (WHC 1988b)

  - EII 1.5, Field Logbooks
  - EII 5.1, Chain of Custody
  - EII 5.4, Field Cleaning and/or Decontamination of Equipment
  - EII 5.8, Groundwater Sampling
  - EII 5.11, Sample Packaging and Shipping
  - EII 10.3, Purgewater Management.

- *Environmental Engineering and Geotechnology Function Procedures*, Volume 4 (WHC 1992)

  - Section 2.2, Groundwater Quality Control Sampling
  - Section 2.5, Temperature Control of Groundwater Sample Storage Refrigerators
  - Section 5.1, Groundwater Measuring and Test Equipment (M&TE) Calibration by User
  - Section 5.2, Groundwater M&TE Calibration by WHC Standards laboratory.

2.2 TREATABILITY TEST SAMPLING PLAN

Groundwater sampling and analysis and hydraulic property evaluation will coincide with treatability testing operations. Activities will be initiated prior to the start of the test to establish baseline conditions. Sampling and evaluation activities will continue during the test at both regular and intermittent intervals as specified in Section 2.2.2.

2.2.1 Well Locations

Wells selected for sampling are those predicted to be within the area of influence of either the proposed extraction or injection wells to be used in the test. Results of the capture zone modeling for wells near the treatability test are presented in Connelly (1994). Well 299-W18-1 has been proposed as the extraction well and 299-W18-4 as the injection well. Wells predicted to be within the zone of influence of the test are: 299-W18-2, 299-W18-5, and 299-W18-24. A location map for these wells is contained in Figure 1. Construction information for these wells is contained in Table 6.
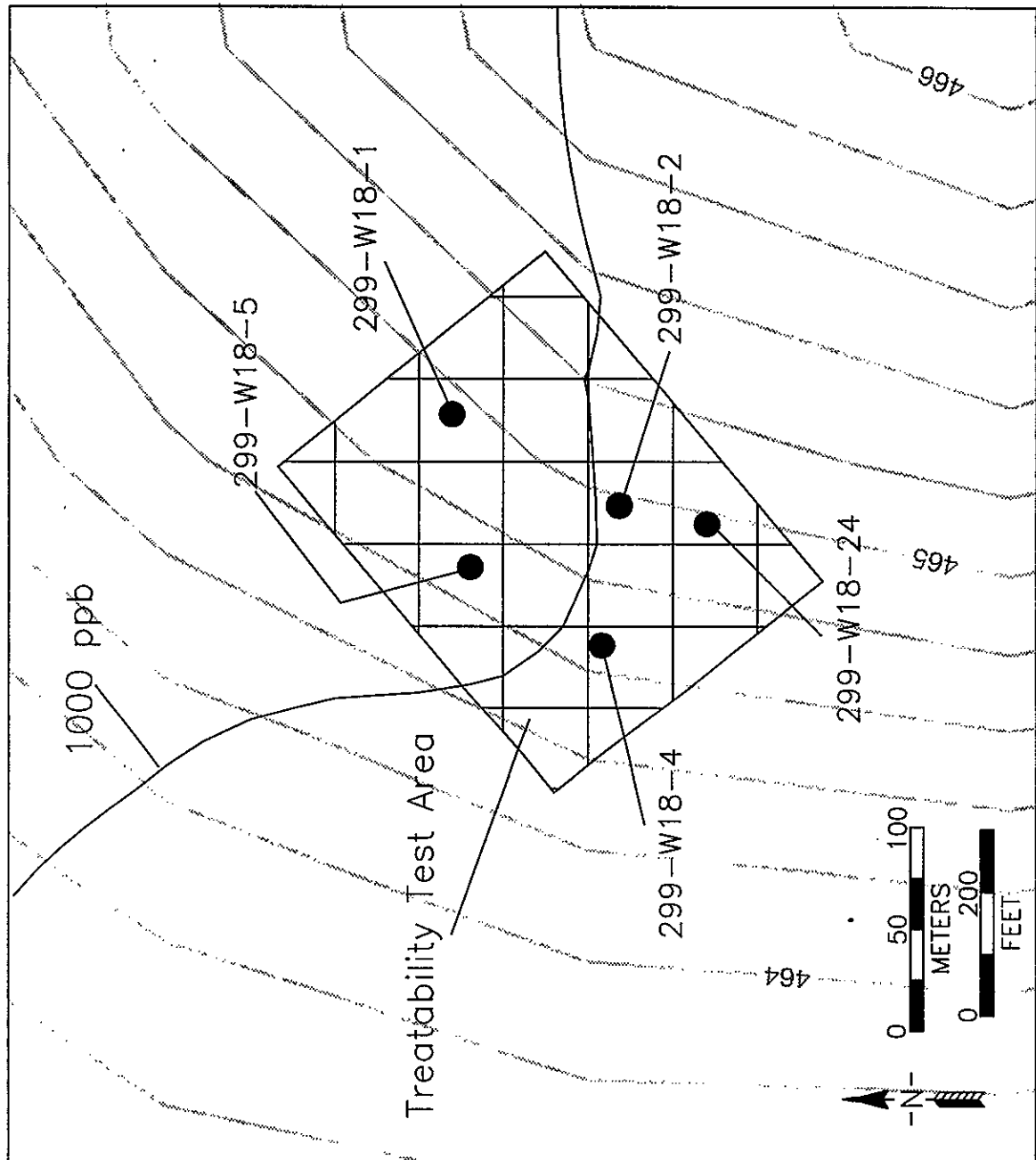
Figure 1. Location Map for Treatability Test Monitoring Wells.

Table 6. Summary of Construction Information for Monitoring Wells
in the Treatability Test Monitoring Network.

Well (299-)	Casing diameter (in)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
W18-1	8	CS[a]	427	195-425	---	---
W18-2	8	CS	280	205-255	212 (3/91)	43
W18-4	8	CS	280	197-254	221 (4/94)	33
W18-5	8	CS	280	195-274	217 (4/93)	57
W18-24	4	SS[b]	240	206-236	218 (3/93)	18

[a]carbon steel
[b]stainless steel.

2.2.2 Schedule

Groundwater sampling and analysis will be scheduled to provide regular interval testing during treatment test operations and intermittent sampling in support of hydraulic property testing. Baseline sampling and water level measurements of all the wells, including the extraction and injection wells, will be taken approximately 7 to 10 days prior to the start of initial extraction well pumping for treatability testing. Groundwater sampling will then be conducted monthly, as a minimum, during the test. If the treatment test is concluded prior to scaleup to a more comprehensive extraction/injection network, a final set of samples will be collected after the test. Network wells will be instrumented for continuous water level measurement during the test.

Tracer testing for the evaluation of hydraulic property parameters will be conducted early in the treatment test (if possible) when a steady pumping rate has been achieved and expected to be maintained. A test plan containing the rationale and test setup for this activity will be provided separately from this document. The ideal tracer should be conservative, nontoxic, inexpensive, and easily detected with relatively simple equipment. In addition, the tracer must be present in concentrations well above background for the same constituent in the aquifer. Lastly, the tracer should not modify any property of the aquifer. Lithium bromide meets all of the specified criteria. The bromide ion will be the tracer of interest for field testing.

2.2.3 Analytes

The list of analytes for both field and offsite laboratory analysis is summarized in Table 7. Samples will be collected and handled using the protocols defined in EII 5.8, Groundwater Sampling (WHC 1988b). Field determinations will be conducted for primary VOC to allow for rapid data turnaround. Offsite analysis will be conducted for primary volatile organics for verification of field results as well as for additional groundwater parameters. Quality control samples for both field and offsite analyses are specified below. Sample custody will follow procedures as outlined in EII 5.1, Chain of Custody (WHC 1988b).

Table 7. List of Analytes for the Treatability Test Monitoring Network.

Analyte	Method	Holding time	Bottle/volume
Field Measurements			
carbon tetrachloride	field GC[a]	14 days	Gs[b] 1X40 ml
chloroform			
trichloroethylene			
nitrate	field method	28 days	
Offsite Laboratory Analysis			
carbon tetrachloride	SW-846, Method 8240 or 8260	14 days	Gs 3X40 ml
chloroform			
trichloroethylene			
nitrate	EPA 300	28 days	G[c] 400 ml
gross alpha	EPA 900	6 months	P[d] 1,000 ml
gross beta	EPA 900	6 months	P 1,000 ml
tritium	liquid scintillation	6 months	P 1,000 ml

[a]gas chromatography
[b]glass w/septum cap
[c]glass
[d]plastic.

2.2.4 Quality Assurance/Quality Control Requirements

Data quality is controlled by this SAP and the quality assurance project plan (QAPjP) provided in Appendix A. The quality assurance (QA) documents that cover the test activities are the *Quality Assurance Manual* (WHC 1988d), and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990).

Quality control samples for field determinations should be collected at the following frequency.

- One duplicate from one well every sampling episode
- One trip blank for each day of sampling
- One method blank from one well every sampling episode.

Quality control/verification samples for offsite Level III or V analyses should be collected at the following frequency:

- One duplicate from one well for every sampling episode
- Two split samples from separate wells from two separate monthly samplings
- One trip blank (VOA only) per sample day
- One equipment blank during every quarter, the first to be collected during baseline sampling.

2.3 REMEDIAL ACTION ASSESSMENT SAMPLING PLAN

Groundwater remedial actions impacts will be assessed by sampling, water level measurement, and velocity flowmeter profiling in a network of wells in high contaminant concentration areas. Baseline sampling and water level measurement will be initiated prior to the start of large-scale remediation activities to refine contaminant distributions for remedial design input. Sampling and evaluation activities will continue during remediation activities at both regular and intermittent intervals as specified in Section 2.3.2.

2.3.1 Well Locations

Initial well locations for baselining primary contaminant distributions and water levels has been based on wells that lie within or define the boundary of the 1,000 μg/kg isopleth of carbon tetrachloride contamination at the water table. Wells monitoring the upper 40 ft of the confined aquifer were considered for inclusion in the initial set of remedial action assessment wells. Little information is available at this time concerning the concentrations of primary contaminants with depth, a few wells completed in deeper portions of the aquifer are included in the network. The deeper well network may be modified at a later date following the vertical contaminant distribution/hydraulic property investigation discussed in Section 3.1. Wells selected for the monitoring network are identified in Table 8 along with pertinent construction information. Two sets of wells are identified, those that will be sampled by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) program alone and those that are already scheduled for sampling by another program. Wells scheduled for other programs will be co-sampled by CERCLA for analytes that are not currently scheduled. A location map for these wells is contained in Figure 2.

Table 8. Summary of Construction Information for Monitoring Wells in the Remedial Action Assessment Monitoring Network.

Well (299-)	Casing diameter (in)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
CERCLA Wells						
W10-1	8	CS[a]	305	190-270	209 (4/92)	61
W10-4	8	CS	245	190-245	207 (1/92)	38
W10-5	8	CS	240	175-220	210 (3/94)	10
W11-7	8	CS	311	245-290	249 (3/94)	41
W11-14	8	CS	315	250-313	258 (3/94)	55
W11-30	4	SS[b]	280	243-280	247 (12/92)	33
W14-9	8	CS	535	416-535	---	---
W15-1	8	CS	300	190-270	200 (7/75)	70
W15-4	8	CS	217	170-216	198 (3/94)	18
W15-6	8/6	CS	410	175-408	194 (3/92)	214
W15-7	8	CS	350	182-350	197 (1/92)	153
W15-10	8	CS	300	183-297	214 (12/93)	83
W15-11	8	CS	300	183-297	209 (1/91)	88
W18-1[c]	8	CS	427	195-425	---	---
W18-5[c]	8	CS	280	195-294	217 (4/93)	57
W19-4	8	CS	550	252-288	258 (9/93)	30
CoSample Wells						
W6-10	4	SS	278	251-271	253 (5/92)	18
W10-15	4	SS	222	201-222	214 (3/94)	8
W10-16	4	SS	220	198-219	211 (3/94)	8
W10-18	4	SS	223	200-221	208 (3/94)	13
W10-19	4	SS	238	214-235	223 (3/94)	12
W11-31	4	SS	267	241-261	245 (2/92)	16
W15-15	4	SS	255	223-253	235 (394)	18
W15-16	4	SS	244	208-238	221 (3/94)	17
W15-17	4	SS	450	423-433	221 (3/94)	10
W15-18	4	SS	243	208-238	222 (3/94)	16
W15-22	4	SS	222	199-220	206 (3/94)	14

Table 8. Summary of Construction Information for Monitoring Wells in the Remedial Action Assessment Monitoring Network. (cont)

Well (299-)	Casing diameter (in)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
W18-23	4	SS	255	220-251	234 (3/94)	17
W18-24	4	SS	240	206-236	221 (3/94)	15

[a]carbon steel
[b]stainless steel
[c]well is identified for sampling in the treatability test network.

2.3.2 Schedule

Groundwater sampling and analysis will be scheduled to establish baseline contaminant, co-contaminant, and general groundwater parameters-of-interest in areas of high contaminant concentration and to detect changes that may be caused by remedial action activities. Hydraulic impacts, as evidenced by water level and velocity flowmeter changes, will also be monitored. Baseline sampling and water level measurements of all the wells will be conducted semiannually beginning in September 1994. Increase in the sampling frequency for a well will occur if either a significant concentration change is noted or if the well falls within a predicted zone of influence of an extraction or injection well or facility.

2.3.3 Analytes

The list of analytes is summarized in Table 9. Samples will be collected and handled using the protocols defined in EII 5.8, Groundwater Sampling (WHC 1988b). Primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) will be determined by offsite analysis (Level IV). Field determinations and/or onsite laboratory analysis will be conducted for all other analytes. Quality control samples, specified below, will be collected and shipped offsite for analysis using Level IV or Level V methodologies (as applicable). Sample custody will follow procedures as outlined in EII 5.1, Chain of Custody (WHC 1988b).

2.3.4 Quality Assurance/Quality Control Requirements

Data quality is controlled by this SAP and QAPjP (Appendix A). The QA documents that cover the test activities are the *Quality Assurance Manual* (WHC 1988d), and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990).
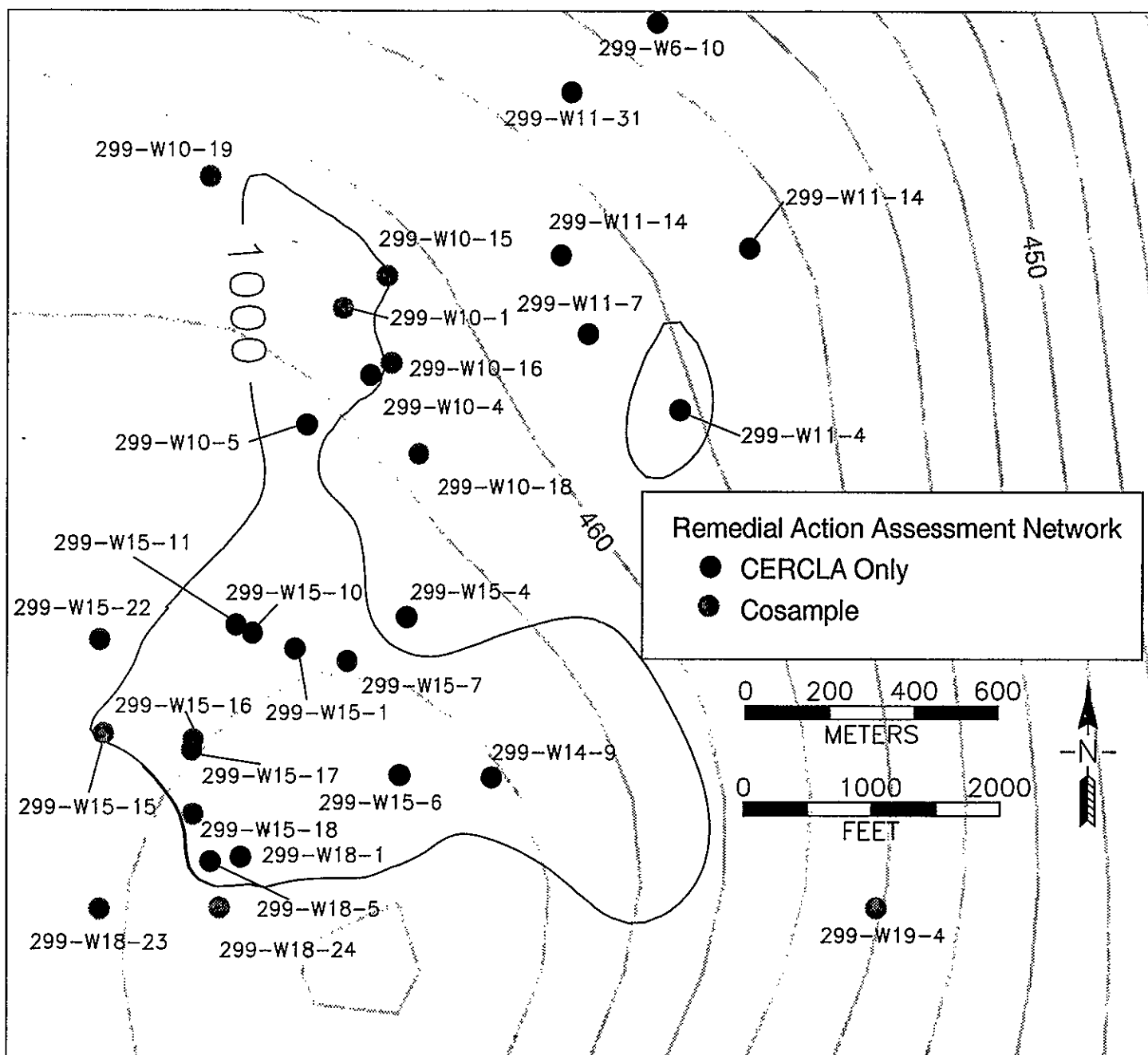
Figure 2. Location Map for Remedial Action Assessment Monitoring Wells.

Table 9. List of Analytes for the Remedial Action Assessment
Monitoring Network.

Analyte	Method	Holding time	Bottle/volume
carbon tetrachloride	SW-846, 8240, or 8260	14 days	Gs[a] 3X40 ml, HCl to pH<2
chloroform	SW-846, 8240, or 8260	14 days	Gs 3X40 ml, HCl to pH<2
trichloroethylene	SW-846, 8240, or 8260	14 days	Gs 3X40 ml, HCl to pH<2
nitrate	field method	28 days	G[b] 400 ml
gross alpha	EPA 900	6 months	P[c] 1,000 ml
gross beta	EPA 900	6 months	P 1,000 ml
tritium	liquid scintillation	6 months	P 1,000 ml

[a]glass w/septum cap
[b]glass
[c]plastic.

Quality control (QC) samples for Level IV or V analysis should be collected at the following frequency:

- One duplicate per every 20 wells or a minimum of one per sampling episode
- One split per every 20 wells or a minimum of one per sampling episode
- One trip blank per cooler designated for offsite shipment
- One matrix spike/matrix spike duplicate (VOA only) per every 20 wells or a minimum of one per sampling episode.

2.4 PLUME PERIPHERY SAMPLING PLAN

The plume periphery well network is designed to monitor contaminant movement out of the 200 West Area. In addition, the network will provide early warning of concentration trends. Baseline sampling will begin concurrent with remedial action assessment baselining.

2.4.1 Well Locations

Nine wells completed within 40 ft of the water table have been selected based on the 10 μg/kg carbon tetrachloride concentration isopleth at the water table along groundwater flow paths (zones of higher hydraulic conductivity). The wells were selected to bracket the 10 μg/kg isopleth where possible. Wells completed deeper in the unconfined and potentially in the confined aquifer system(s) may be added to the network based on the results of the vertical

contaminant/hydraulic property investigation discussed in Section 3.1. Wells selected for the monitoring network are identified in Table 10 along with pertinent construction information. A location map for these wells is contained in Figure 3.

Table 10. Summary of Construction Information for Monitoring Wells in the Plume Periphery Monitoring Network.

Well	Casing diameter (in)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
299-W6-5	4	SS[a]	287	264-285	256 (10/91)	21
299-W7-5	4	SS	229	207-228	217 (3/94)	11
299-W10-13	4	SS	250	227-247	234 (3/93)	13
299-W11-10	8	CS[b]	307	256-304	275 (12/93)	29
299-W12-1	8	CS	314	274-309	278 (12/93)	31
699-37-82A	8	CS	175	155-175	172 (12/93)	3
699-38-70	8	CS	295	255-295	260 (12/93)	35
699-39-79	8	CS	236	195-236	211 (3/94)	25
699-48-71	8	CS	305	239-302	244 (6/93)	58

[a]stainless steel
[b]carbon steel

2.4.2 Schedule

Groundwater sampling and analysis and water level measurement will be scheduled to evaluate concentration trends of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene). Sampling of all wells in the network will be conducted semiannually beginning in September 1994. Increase in the sampling frequency for a well may occur if a significant concentration change is detected.

2.4.3 Analytes

Primary IRM contaminants are to be analyzed for all network wells (Table 11). Analysis will be performed by an offsite laboratory (Level IV). Samples will be collected and handled using the protocols defined in EII 5.8, Groundwater Sampling (WHC 1988b). Quality control samples, specified below, will be collected and shipped offsite for analysis using Level IV methodologies. Sample custody will follow procedures as outlined in EII 5.1, Chain of Custody (WHC 1988b).
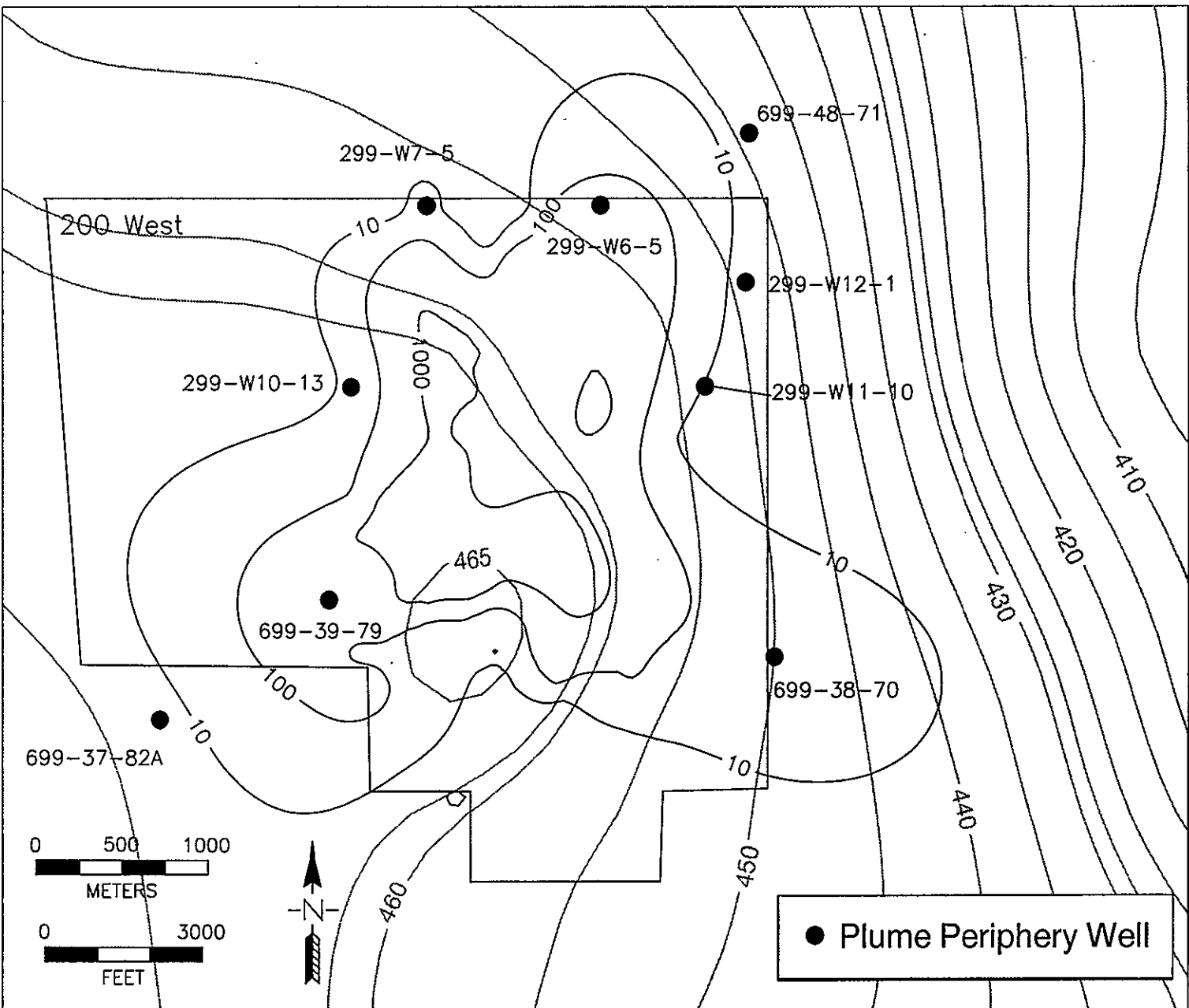
Figure 3. Location Map for Plume Periphery Monitoring Wells.

699−48−71

299−W7−5

200 West

299−W6−5

299−W12−1

299−W10−13

299−W11−10

699−39−79

465

410

420

430

699−38−70

699−37−82A

440

450

460

0   500   1000
METERS

0   3000
FEET

−N−

• Plume Periphery Well

Table 11. List of Analytes for the Plume Periphery Monitoring Network.

Analyte	Method	Holding time (days)	Bottle/volume
carbon tetrachloride	SW-846, 8240, or 8260	14	Gs[a] 3X40 ml, HCl to pH<2
chloroform	SW-846, 8240, or 8260	14	Gs 3X40 ml, HCl to pH<2
trichloroethylene	SW-846, 8240, or 8260	14	Gs 3X40 ml, HCl to pH<2

[a]glass w/septum cap

2.4.4 Quality Assurance/Quality Control Requirements

Data quality is controlled by this SAP and QAPjP (Appendix A). The QA documents that cover the test activities are the *Quality Assurance Manual* (WHC 1988d), and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990).

Quality control samples for Level IV analysis should be collected at the following frequency:

- One duplicate per every 20 wells or a minimum of one per sampling episode
- One split per every 20 wells or a minimum of one per sampling episode
- One trip blank per cooler designated for offsite shipment
- One matrix spike/matrix spike duplicate (VOA only) per every 20 wells or a minimum of one per sampling episode.

2.5 POINT OF COMPLIANCE SAMPLING PLAN

This monitoring network is designed to provide for detection of volatile organic contaminants at a "point" of compliance. The analytical results will be evaluated against regulatory standards to determine if concentrations exceed the standards and compliance actions must be initiated. Sampling of the network will initiate concurrently with the remedial action assessment and plume periphery network programs.

2.5.1 Well Locations

The network is comprised of three wells as listed in Table 12. The wells monitor the upper portion of the unconfined aquifer. The network may be modified the include wells completed deeper in the unconfined aquifer based on the results of the vertical contaminant/ ydraulic property investigation discussed in Section 3.1. A location map for the network is provided in Figure 4.

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Table 12. Summary of Construction Information for Monitoring Wells
in the Point of Compliance Monitoring Network.

Well (699-)	Casing diameter (in)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
34-88	8	CS[a]	210	156-210	165 (6/93)	45
47-60	8	CS	278	250-277	251 (3/94)	26
51-63	8	CS	185	157-180	168 (12/93)	12

[a]carbon steel

2.5.2 Sampling Schedule

Groundwater sampling and analysis will be conducted semiannually beginning in September 1994. If contaminant concentrations exceed regulatory standards then the frequency of sampling will be addressed as part of a compliance plan. At a minimum, any exceedance must be reconfirmed by immediate resampling of the well in which the exceedance occurs.

2.5.3 Analytes

Primary IRM VOC (Table 13) will be collected semiannually and handled using the protocols defined in EII 5.8, Groundwater Sampling (WHC 1988b). The analyses will be conducted by an offsite laboratory (Level IV). Quality control samples, specified below, will be collected and shipped offsite for analysis using Level IV methodologies. Sample custody will follow procedures as outlined in EII 5.1, Chain of Custody (WHC 1988b).

Table 13. List of Analytes for the Point-of-Compliance Monitoring Network.

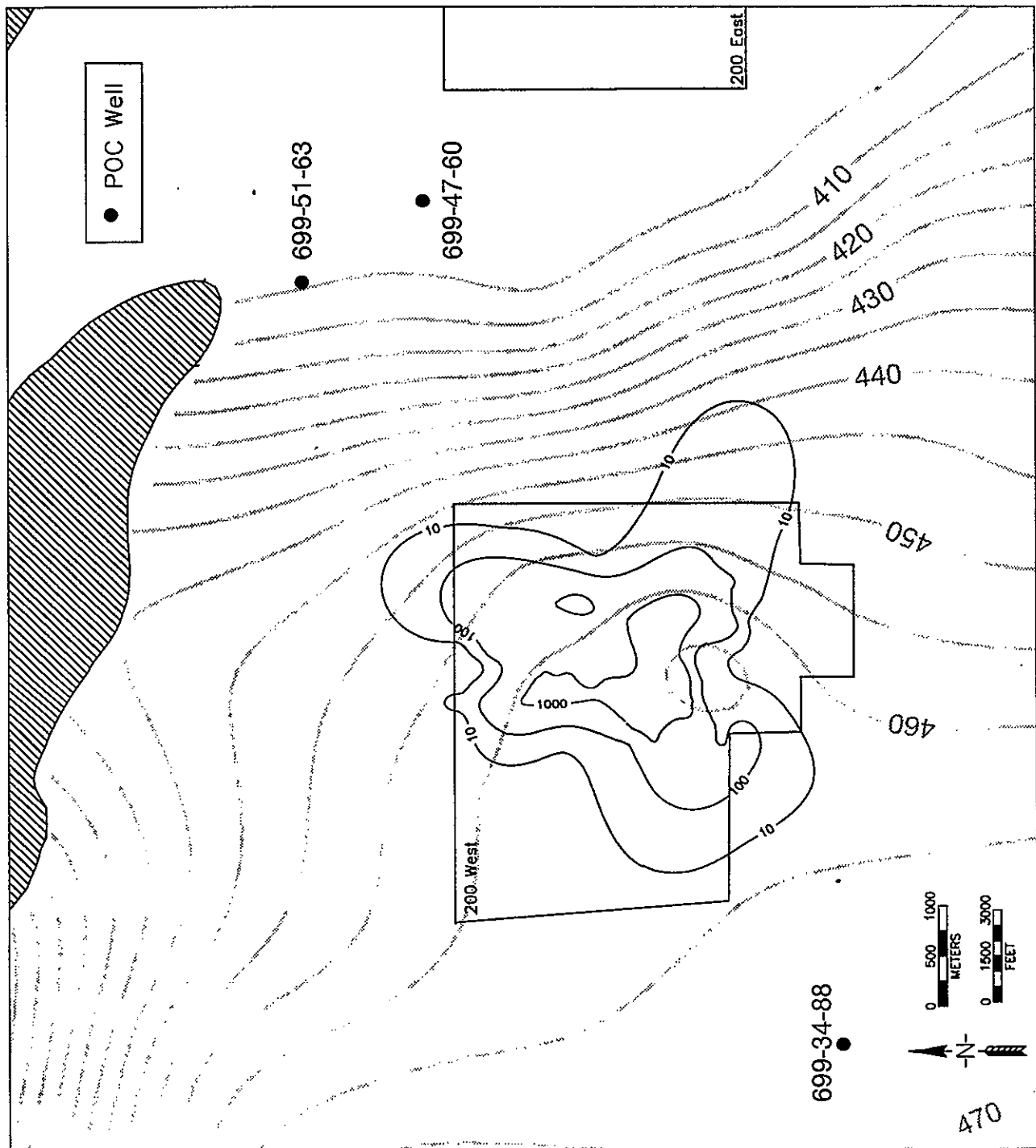| Analyte	Method	Holding time (days)	Bottle/volume
carbon tetrachloride	8240	14	Gs[a] 3X40 ml, HCl to pH<2
chloroform	8240	14	Gs 3X40 ml, HCl to pH<2
trichloroethylene	8240	14	Gs 3X40 ml, HCl to pH<2

[a]glass w/septum cap

Figure 4. Location Map for Point of Compliance Monitoring Wells.

2.5.4 Quality Assurance/Quality Control Requirements

Data quality is controlled by this SAP and QAPjP (Appendix A). The QA documents that cover the test activities are the *Quality Assurance Manual* (WHC 1988d), and the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990).

Quality control samples for Level IV analysis should be collected at the following frequency:

- One duplicate per every 20 wells or a minimum of one per sampling episode
- One split per every 20 wells or a minimum of one per sampling episode
- One trip blank per cooler designated for offsite shipment.

2.6 HEALTH AND SAFETY

All field personnel working to this sampling and analysis plan will have completed the 40-Hour Hazardous Waste Site Worker Training Program and will perform all work in accordance with the following:

- *Westinghouse Radiological Control Manual* (WHC 1993)
- *Health Physics Practices Manual* (WHC 1988b)
- *Industrial Safety Manual* (WHC 1987)
- *Environmental Compliance Manual* (WHC 1988a)
- Applicable safety documentation.

3.0 SUPPORTING WORK

Two supporting studies have been identified that may be conducted and provide remedial design information that will probably necessitate changes to the monitoring networks as proposed in this document. These two studies are mentioned briefly in this section to clarify their relationship to the groundwater monitoring networks. Each study will be detailed in separate descriptions of work (DOW).

3.1 DENSE NON-AQUEOUS PHASE LIQUIDS BENEATH 216-Z-9 TRENCH

Unresolved questions exist regarding the distribution and physical state of carbon tetrachloride, a dense, non-aqueous phase liquid (DNAPL), in the unconfined aquifer. The occurrence and extent of the DNAPL is a critical data need for the 200-ZP-1 IRM remedial

design. The near-term preferred remediation alternative for the 200-ZP-1 IRM is extraction of groundwater combined with surface treatment and reinjection of treated groundwater. This remediation technology, called "pump and treat", has been used extensively to treat groundwater contamination problems. Although widely used, successful implementation of pump and treat has suffered at many DNAPL sites due primarily to insufficient data on the chemical and physical behavior of the contaminants in the subsurface. The proposed investigation will focus on the presence of carbon tetrachloride beneath one disposal facility.

Results from the investigation have the potential to influence future locations and monitoring intervals in the unconfined aquifer. All four networks may be affected. Once the results are available, the networks will be reassessed.

3.2 VERTICAL DISTRIBUTION OF DENSE NON-AQUEOUS PHASE LIQUIDS

Recent investigations of contaminant distributions at depth in the unconfined aquifer have given indications that two of the 200-ZP-1 primary contaminants (carbon tetrachloride and chloroform) may be present at depths up to 80 ft beneath the water table (need reference no personal communication). New well sites and newer sampling methodologies may soon provide better quality sampling results to verify the initial results. The distribution of these contaminants in the unconfined aquifer is a critical element of remedial design. This proposed investigation would address the vertical distribution of DNAPLs beneath the 200 West Area.

Results from the investigation have the potential to influence future locations and monitoring intervals in the unconfined aquifer. All four networks may be affected. Once the results are available, the networks will be reassessed.

4.0 REFERENCES

Connelly, M. P., 1994, *Capture Zone Analysis for the 200-ZP-1 and 200-UP-1 Pilot Scale Pump-and-Treat Tests*, WHC-SD-EN-TI-252, Westinghouse Hanford Company, Richland, Washington.

EPA, 1991, *USEPA Contract Laboratory Program Statement of Work for Organic Analysis*, U.S. Environmental Protection Agency, Washington, D.C.

WHC, 1987, *Industrial Safety Manual*, WHC-CM-4-3, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988a, *Environmental Compliance Manual*, WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988b, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988c, *Health Physics Practices Manual*, WHC-IP-0718, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988d, *Quality Assurance Manual*, WHC-CM-4-2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1990, *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan*, WHC-EP-0383, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Environmental Engineering and Geotechnology Function Procedures*, WHC-CM-7-8, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993, *Westinghouse Radiological Control Manual*, WHC-CM-1-6, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN (QAPjP)

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GLOSSARY

Accuracy: For the purposes of environmental investigations, accuracy may be interpreted as the measure of the bias in a system. Sampling accuracy is normally assessed through the evaluation of matrix-spiked samples, reference samples, and split samples.

Audit: For the purposes of environmental investigations, audits are considered to be systematic checks to verify the quality of operation of one or more elements of the total measurement system. In this sense, audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained in a measurement system, or (2) system audits, involving a qualitative onsite evaluation of laboratories or other organizational elements of the measurement system for compliance with established quality assurance program and procedure requirements. For environmental investigations at the Hanford Site, performance audit requirements are fulfilled by periodic submittal of blind samples to the primary laboratory, or the analysis of split samples by an independent laboratory. System audit requirements are implemented through the use of standard surveillance procedures.

Bias: Bias represents a systematic error that contributes to the difference between a population mean of a set of measurements and an accepted reference or true value.

Blind Sample: A blind sample refers to any type of sample routed to the primary laboratory for performance audit purposes, relative to a particular sample matrix and analytical method. Blind samples are not specifically identified as such to the laboratory. They may be made from traceable standards, or may consist of sample material spiked with a known concentration of a known compound. See the glossary entry for Audit.

Comparability: For the purposes of environmental investigations, comparability is an expression of the relative confidence with which one data set may be compared with another.

Completeness: For the purposes of environmental investigations, completeness may be interpreted as a measure of the amount of valid data obtained compared to the total data expected under correct normal conditions.

Deviation: For the purposes of environmental investigations, deviation refers to an approved departure from established criteria that may be required as a result of unforeseen field situations or that may be required to correct ambiguities in procedures that may arise in practical applications.

Equipment Blanks: Equipment blanks consist of pure deionized, distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. They are used to verify the adequacy of sampling equipment decontamination procedures, and are normally collected at the same frequency as field duplicate samples.

Field Blanks: Field blanks for water analyses consist of pure deionized, distilled water, transferred to a sample container at the site and preserved with the reagent specified for the analytes of interest. They are used to check for possible contamination originating with the reagent or the sampling environment, and are normally collected at the same frequency as field duplicate samples.

Field Duplicate Sample: Field duplicate samples are samples retrieved from the same sampling location using the same equipment and sampling technique, placed in separate, identically prepared and preserved containers, and analyzed independently. Field duplicate samples are generally used to verify the repeatability or reproducibility of analytical data, and are normally analyzed with each analytical batch or every 20 samples, whichever is greater.

Matrix-Spiked Samples: Matrix-spiked samples are a type of laboratory quality control sample. They are prepared by splitting a sample received from the field into two homogenous aliquots (i.e., replicate samples) and adding a known quantity of a representative analyte of interest to one aliquot in order to calculate the percentage of recovery of that analyte.

Nonconformance: A nonconformance is a deficiency in the characteristic, documentation, or procedure that renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When the deficiency is of a minor nature, does not effect a permanent or significant change in quality if it is not corrected, and can be brought into conformance with immediate corrective action, it shall not be categorized as a nonconformance. If the nature of the condition is such that it cannot be immediately and satisfactorily corrected, however, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision: Precision is a measure of the repeatability or reproducibility of specific measurements under a given set of conditions. The relative percent difference (RPD) is used to assess the precision of the sampling and analytical method. The RPD is a quantitative measure of the variability. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is normally expressed in terms of standard deviation, but may also be expressed as the coefficient of variation (i.e., relative standard deviation) and range (i.e., maximum value minus minimum value). Precision is assessed by means of duplicate/replicate sample analysis.

Quality Assurance: For the purposes of environmental investigations, quality assurance refers to the total integrated quality planning, quality control, quality assessment and corrective action activities that collectively ensure that the data from monitoring and analysis meets all end user requirements and/or the intended end use of the data.

Quality Assurance Project Plan: The quality assurance project plan is an orderly assembly of management policies, project objectives, methods and procedures that defines how data of known quality will be produced for a particular project or investigation.

Quality Control: For the purposes of environmental investigations, quality control refers to the routine application of procedures and defined methods to the performance of sampling, measurement and analytical processes.

Range: Range refers to the difference between the largest and smallest reported values in a sample, and is a statistic for describing the spread in a set of data.

Reference Samples: Reference samples are a type of laboratory quality control sample prepared from an independent, traceable standard at a concentration other than that used for analytical equipment calibration, but within the calibration range. Such reference samples are required for every analytical batch or every 20 samples, whichever is greater.

Replicate Sample: Replicate samples are two aliquots removed from the same sample container in the laboratory and analyzed independently.

Representativeness: For the purposes of environmental investigations, representativeness may be interpreted as the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of a sampling program.

Split Sample: A split sample is produced through homogenizing a field sample and separating the sample material into two equal aliquots. Field split samples are usually routed to separate laboratories for independent analysis, generally for purposes of auditing the performance of the primary laboratory relative to a particular sample matrix and analytical method. See the glossary entry for Audit. In the laboratory, samples are generally split to create matrix-spiked samples (see the glossary entry).

Volatile Organics Analysis Trip Blanks: Volatile organics analysis trip blanks are a type of field quality control sample, consisting of pure deionized distilled water in a clean, sealed sample container, accompanying each batch of containers shipped to the sampling site and returned unopened to the laboratory. Trip blanks are used to identify any possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions.

Validation: For the purposes of environmental investigations, validation refers to a systematic process of reviewing data against a set of criteria to provide assurance that the data are acceptable for their intended use. Validation methods may include review of verification activities, editing, screening, cross-checking, or technical review.

Verification: For the purposes of environmental investigations, verification refers to the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities may include inspections, audits, surveillance, or technical review.

CONTENTS

CONTENTS (cont)

TABLE A-1.

1.0 INTRODUCTION

The purpose of this QAPjP is to support data collection activities associated with 200-ZP-1 groundwater monitoring SAP presented in the first part of this document. Plan activities will consist of sampling and analysis in support of treatability testing, remedial action impact assessment, plume migration analysis, and point-of-compliance monitoring.

This QAPjP was prepared in compliance with the requirements of *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990b); WHC (1990b) describes the means selected to implement the overall QA program requirements defined by the *Quality Assurance Manual* (WHC 1988b), as applicable to environmental investigations, while accommodating the specific requirements for project plan format and content agreed upon in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989). Distribution and revision control of the treatability test plan and the QAPjP will be performed in compliance with Quality Requirement (QR) QR 6.0, Document Control and other applicable procedures as identified in the QA Program Index (QAPI) included in WHC (1990b).

Interim changes to this QAPjP or the treatability test plan shall be documented, reviewed, and approved as required by Section 6.6 of EII 1.9, Primary and Secondary Document Review and Control (WHC 1988a), and shall be documented in monthly unit managers' meeting minutes. The QAPjP distribution shall routinely include all review/approval personnel indicated on the title page of the document and all other individuals designated by the WHC technical lead. All plans and procedures referenced in the QAPjP are available for regulatory review on request at the direction of the technical lead.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The following sections identify responsibilities of project personnel. The overall organization for the pilot-scale testing is provided in Section 8.0 of the treatability test plan.

2.1 QUALITY ASSURANCE OFFICER RESPONSIBILITIES

The QA officer (i.e., cognizant QA manager) is responsible for coordination and/or oversight of performance to the QAPjP requirements by means of internal auditing and surveillance techniques. The QA officer has the necessary organizational independence and authority to identify conditions adverse to quality and to inform the technical lead of needed corrective action.

2.2 TECHNICAL LEAD RESPONSIBILITIES

The WHC Environmental Restoration Engineering Group has primary responsibilities for conducting this investigation. Responsibility descriptions and individual WHC field team descriptions are addressed in the governing project procedures identified in Section 4.0 of this QAPjP.

External participant contractors or subcontractors shall be evaluated and selected for certain portions of task activities at the direction of the technical lead in compliance with procedures QR 4.0, Procurement Document Control, QR 7.0, Control of Purchased Items and Services (WHC 1988b), and other procedures as identified under criteria four and seven of the QAPI included in WHC (1990b). All contractor or subcontractor plans and procedures shall be approved before their use, and shall be available for regulatory review after WHC approval.

2.3 ANALYTICAL LABORATORIES

The field sampling team will be responsible for screening all samples for radioactivity in compliance with the *Radiation Protection Manual* (WHC 1988c).

Samples shall be packaged and shipped in compliance with Section 6.3 of EII 5.11, Sample Packaging and Shipping (WHC 1988a). If the total activity of a sample is equal to or greater than 200 pCi/g, or if the alpha activity of the sample is equal to or greater than 60 pCi/g, the sample will be routed to a WHC or Hanford Site participant contractor or subcontractor laboratory equipped and qualified to handle the analysis of radioactive samples. Samples that do not exceed either of the above criteria may be routed to any approved participant contractor or subcontractor analytical laboratory.

All analyses shall be coordinated through Hanford Analytical Services Management (HASM) and shall be performed in compliance with WHC-approved laboratory QA plans and analytical procedures; all analytical laboratories shall be subject to the surveillance controls described by Quality Instruction (QI) 10.4, Surveillance (WHC 1988b). For subcontractors or participant contractors, applicable quality requirements shall be invoked as part of the approved procurement documentation or work order (Section 3.0 and 4.1.2 of this QAPjP). Services of alternate qualified laboratories shall be procured for radioactive sample analysis if onsite laboratory capacity is not available, and/or for the performance of split sample analysis at the technical lead's discretion. If such an option is selected, the laboratory shall provide objective evidence of appropriate Nuclear Regulatory Commission or state radioactive materials handling licenses. The laboratory shall submit its QA plan and applicable analytical procedures for WHC approval prior to their use, as noted in Section 4.1.2 of this QAPjP.

2.4 OTHER SUPPORT CONTRACTORS

Procurement of all other field services and supporting items, materials, or equipment shall comply with standard procurement procedures as discussed in Sections 2.1 and 4.1 of this QAPjP. All work shall comply with WHC-approved QA plans and/or procedures, and is subject to the controls of QI 10.4, Surveillance (WHC 1988b). Applicable QRs shall be invoked as part of the approved procurement documentation or work order as noted in Section 4.1 of this QAPjP.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENTS

The rationale for establishing DQOs and data needs for this investigation is presented in Section 1.0 of the SAP. Chemical analyses and QA/QC requirements are presented in Section 2.0 of the SAP, along with analytical method requirements and maximum detection or quantitation limit values and maximum acceptable ranges for precision and accuracy. Data analysis may use Hanford Site laboratories analyses at (Level II) or field methods (Level I or II) where specified and possible.

Where EPA Contract Laboratory Program (CLP) methods are specified, the Contract Required Detection Limits (CRDLs) for inorganic parameters, Contract Required Quantitation Limits (CRQLs) for organic parameters, and the maximum precision and accuracy ranges specified for each parameter by the appropriate CLP Statements of Work (SOWs) apply without modification; see *USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis: Multi-Media, Multi-Concentration* (EPA 1991a) and *USEPA Contract Laboratory Program Statement of Work for Organics Analysis: Multi-Media, Multi-Concentration* (EPA 1991b). For non-CLP parameters, CRQLs and precision and accuracy ranges are provided that shall be considered maximum values that can be reliably achieved by analytical laboratories under routine conditions.

The requirements of Table A-1 shall be considered a minimum performance standard for characterizing groundwater and solids, and shall be incorporated into the agreements for services established with individual WHC, participant contractor, or subcontractor analytical laboratories. Any modification of Table A-1 requirements shall be justified by the requestor, and shall be considered a formal modification of this QAPjP, and is subject to regulatory review and approval.

Goals for data representativeness will be addressed qualitatively by the specification of sampling locations and frequencies, as previously described in the SAP. Sampling practices will be specified in operating procedures and work orders issued to the subcontractors or participating contractors responsible for conducting sampling activities. Objectives for the completeness of the pilot-scale testing shall require that contractually or procedurally

established requirements for precision and accuracy be met for at least 90% of the total number of requested determinations. Failure to meet this criterion shall be documented and evaluated in the validation process described in Section 8.0 of this QAPjP; corrective action shall be taken as warranted, as described in Section 13.0. Approved analytical procedures shall require the use of the reporting techniques and units specified in EPA reference methods in Table A-1 to facilitate the comparability of data sets in terms of precision and accuracy.

4.0 SAMPLE PROCEDURES

4.1 PROCEDURE APPROVALS AND CONTROL

4.1.1 Westinghouse Hanford Company Procedures

The WHC procedures cited in this QAPjP have been selected from the QAPI included in WHC (1990b). Selected procedures include EIIs WHC (1988a), and QRs and QIs from WHC (1988b). Procedure approval, revision, and distribution control requirements applicable to EIIs are addressed in EII 1.2, Preparation and Revision of Environmental Investigations Instructions (WHC 1988a); requirements applicable to QIs and QRs are addressed in QR 5.0, Instructions, Procedures, and Drawings (WHC 1988b). Other procedures applicable to the preparation, review, approval, and revision of other WHC organizations shall be as defined in the various procedures and manuals identified in the QAPI under criteria 5.0 and 6.0. All procedures are available for regulatory review on request, at the direction of the technical lead.

4.1.2 Participant Contractor/Subcontractor Procedures

As previously noted in Section 2.0, participant contractor and/or subcontractor services shall be procured under the applicable requirements of QR 4.0, Procurement Document Control, QR 7.0, Control of Purchased Items and Services (WHC 1988b), and other procedures as identified under criteria four and seven of the QAPI included in WHC (1990b). Submittal requirements of procedures for review and approval before use shall be included in the procurement document or work order, as applicable, when such services require procedural controls. Analytical laboratories shall be required to submit the current version of their internal QA program plans, in addition to analytical procedures. All analytical laboratory plans and procedures shall be reviewed and approved before use by qualified personnel from the Analytical Laboratories organization, or other qualified personnel, as directed by the technical lead. All reviewers shall be qualified under the requirements of EII 1.7, Indoctrination, Training, and Qualification (WHC 1988a). All participant contractor or subcontractor procedures, plans, and/or manuals shall be retained as project records in

compliance with Section 2.0 of *Document Control and Records Management Manual* (WHC 1990a). All such documents are available for regulatory review on request, at the direction of the technical lead.

4.2 SAMPLING PROCEDURES

4.2.1 Sample Acquisition

Sample acquisition procedures are described in the SAP, Section 2.0.

4.2.2 Sample Container Selection

Recommended sample container types, preservation requirements, preparation requirements, and special handling requirements are defined in EII 5.8, Groundwater Sampling; and EII 5.11, Sample Packaging and Shipping (WHC 1988a).

4.3 OTHER SUPPORTING PROCEDURES

Documentation requirements shall be addressed within individual procedures and/or the Information Management Overview (IMO) as appropriate. Analytical procedures are listed in Table A-1.

4.4 PROCEDURE CHANGES

Should deviations from established EIIs be required to accommodate unforeseen field situations, they may be authorized by the field team leader in accordance with the requirements specified in EII 1.4, Instruction Change Authorizations (WHC 1988a). Documentation, review and disposition of instruction change authorization forms shall be defined by EII 1.4. Other types of procedure change requests shall be documented as required by QR 6.0, Document Control (WHC 1988b) or other procedures as identified under criterion six of the QAPI included in WHC (1990b).

5.0 SAMPLE CUSTODY

All samples obtained during the course of this investigation shall be controlled as required by EII 5.1, Chain of Custody (WHC 1988a), from the point of origin to the analytical

laboratory. Laboratory chain-of-custody procedures shall be reviewed and approved in compliance with the requirements of Section 4.1 of this QAPjP, and shall ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the technical lead, requirements for the return of residual sample materials after completion of analysis shall be defined in accordance with procedures described in the procurement documentation to subcontractor or participant contractor laboratories. Chain-of-custody forms shall be initiated for returned residual samples as required by the approved procedures applicable within the laboratory. All analytical results shall be controlled as permanent project quality records as required by Section 9.0 of WHC (1990a).

6.0 CALIBRATION PROCEDURES

Calibration of all measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled as required by QR 12.0, Control of Measuring and Test Equipment (WHC 1988b), other procedures as identified under criterion 12 of the QAPI included in WHC (1990b), and/or specific requirements incorporated in the text of investigation-specific DOWs prepared in compliance with EII 1.14, Preparation of Descriptions of Work (WHC 1988a). Routine operational checks for WHC field equipment shall be as defined within applicable EIIs or procedures; similar information shall be provided in WHC-approved participant contractor or subcontractor procedures or included in the text of applicable DOWs as indicated above. All calibration requirements applicable to analytical laboratory equipment shall be as defined by laboratory QA plans and/or applicable standard analytical methods, subject to review and approval.

7.0 ANALYTICAL PROCEDURES

All analytical methods pertinent to groundwater sampling and analysis are listed in Table A-1, cross-referenced to the parameters of interest and the maximum detection or quantitation limit values and maximum acceptable ranges for precision and accuracy for both water and solid matrices. Where EPA CLP methods are specified, the CRDLs for inorganic parameters, the CRQLs for organic parameters, and the maximum precision and accuracy ranges specified for each parameter by the appropriate CLP SOWs apply without modification (see EPA 1991a and 1991b). For non-CLP parameters, CRQLs and precision and accuracy ranges are provided that shall be considered maximum values, which can be reliably achieved by analytical laboratories. In order to facilitate the comparability of data sets in terms of precision and accuracy, all analytical data shall be reported in the standard units specified in the applicable reference method. The reporting requirements so defined and the applicable requirements of Table A-1 shall be considered minimum performance standards that shall be

incorporated into the agreements for services established with individual WHC participant contractors, or subcontractor analytical laboratories. As previously noted in Section 3.0 of this QAPjP, any modification of Table A-1 requirements shall be justified by the requestor, and shall be considered a formal modification of this QAPjP, and is subject to regulatory review and approval.

All analytical procedures approved for use in this investigation shall require the use of the standard units specified by the analytical methods referenced in Table A-1, to facilitate the comparability of data sets in terms of precision and accuracy. All approved procedures shall be retained in the project quality records and shall be available for review on request.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION AND DATA PACKAGE PREPARATION

All analytical laboratories shall be responsible for preparing a report summarizing the results of analysis and for preparing a detailed data package that includes identifying samples, sampling and analysis dates, raw analytical data, reduced data, data outliers, reduction formulas, recovery percentages, QC check data, equipment calibration data, supporting chromatogram or spectrograms, and documentation of any nonconformances affecting the measurement system in use during the analysis of the particular group of samples. Data reduction schemes shall be contained within individual laboratory analytical methods and/or QA manuals, submitted for WHC review and approval as discussed in Section 4.1 of this QAPjP. The completed data package shall be reviewed and approved by the analytical laboratory's QA manager (or field team leader for field screening type analysis) before its submittal to the technical lead. Completed data packages shall be submitted to the HASM for tracking and data validation functions. The requirements of this section shall be included in procurement documentation or work orders, as appropriate, to comply with the standard procurement control procedures noted in Section 4.1 of this QAPjP.

8.2 VALIDATION

Validation of the completed data package will be performed by qualified HASM personnel or by a qualified independent participant contractor. Subcontracted validation responsibilities shall be defined in procurement documentation or work orders as appropriate. All validation shall be performed in compliance with *Sample Management Administration Manual* (WHC 1990d), Section 2.1 for inorganics analyses, Section 2.2 for organics analyses, and Sections 2.3 and 2.4 for radionuclide analysis. All data packages shall be verified; 10% shall receive full validation in compliance with WHC (1990d) requirements. Data packages requiring full validation shall be specified by the technical lead.

8.3 FINAL REVIEW AND RECORDS MANAGEMENT CONSIDERATIONS

All verification and validation reports and supporting analytical data packages shall be subject to a final technical review by a qualified reviewer at the direction of the technical lead, before their submittal to regulatory agencies; prior to entry into the Hanford Environmental Information System (HEIS) in compliance with EII 14.1, Analytical Laboratory Data Management (WHC 1988a); or before inclusion in reports or technical memoranda. All verification and validation reports, data packages, and review comments shall be retained as permanent project quality records in compliance with Section 9.0 of WHC (1990a).

8.4 REQUIREMENTS FOR HANDLING UNACCEPTABLE OR SUSPECT DATA

The analytical data flow and data management process is described in detail in EII 14.1, Analytical Laboratory Data Management (WHC 1988a). Data errors or procedural discrepancies related to laboratory analytical processes shall prompt data requalification by the validator, requests for reanalysis, or other appropriate corrective action by the responsible laboratory as required by governing HASM or approved subcontractor data validation procedures. If sample holding time requirements are compromised, insufficient sample material is available for reanalysis, or any other condition prevents compliance with governing analytical methods and data validation protocols, the situation shall be formally documented as a nonconformance in compliance with QR 15.0, Control of Nonconforming Items (WHC 1988b).

Corrective action requests shall be prepared in compliance with requirements of QR 16.0, Corrective Action (WHC 1988b), and brought to the immediate attention of the technical lead and QA Coordinator for their appropriate action. If problems are observed with validated data, either as part of the data assessment process described in Section 12.0 of this QAPjP or if separately observed by any of the operable unit managers, the data shall be documented as a nonconformance and corrective action initiated as previously noted; if the data have been entered in the HEIS, the HEIS Data Custodian shall be immediately notified in order that the data may be flagged (in compliance with EII 14.1, Analytical Laboratory Data Management (WHC 1988a) and *HEIS User's Manual* [WHC 1990c]) as suspect, pending resolution of the nonconformance and completion of all required corrective actions.

9.0 INTERNAL QUALITY CONTROL

All analytical samples shall be subject to in-process QC measures in both the field and laboratory. Unless otherwise specified in the approved SOWs or work orders for sampling activities, or in applicable EIIs, the following minimum field QC requirements shall apply.

These requirements are adapted from *Test Methods for Evaluating Solid Waste* (EPA 1986), as modified by the proposed rule changes included in the Federal Register, 1989, Volume 54, No. 13, pp 3212-3228, and 1990, Volume 55, No. 27, pp 4440-4445.

- Field duplicate samples. For each shift of sampling activity under an individual sampling subtask, a minimum of 5% of the total collected samples shall be duplicated, or one duplicate shall be collected for every 20 samples, whichever is greater. Duplicate samples shall be retrieved from the same sampling location using the same equipment and sampling technique, and shall be placed into two identically prepared and preserved containers. All field duplicates shall be analyzed independently to assess the magnitude of field variability and the need for more duplicates.

- Split samples. Upon specific WHC or regulator request, and at the technical lead's direction, field or field duplicate samples may be split in the field and sent to an alternative laboratory as a performance audit of the primary laboratory. Frequency shall meet the minimum schedule requirements of Chapter 10.0 of this QAPjP or the specific needs of the requesting organization.

- Blind samples. At the technical lead's discretion, blind reference samples may be introduced into any sampling round as a QC check of the primary laboratory. Blind sample type shall be as directed by the technical lead; frequency shall meet the minimum schedule requirements in Chapter 10.0 of this QAPjP.

- Field blanks. Field blanks shall consist of pure deionized distilled water, transferred into a sample container at the site and preserved with the reagent specified for the analytes of interest. Field blanks are used as a check on reagent and environmental contamination, and shall be collected at the same frequency as field duplicate samples.

- Equipment rinsate blanks. Equipment blanks shall consist of pure deionized distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks are used to verify the adequacy of sampling equipment decontamination procedures, and shall be collected at the same frequency as field duplicate samples where applicable.

- Volatile organic analysis trip blanks. Volatile organic analysis (VOA) trip blanks consist of pure deionized distilled water added to one clean sample container, accompanying each batch (cooler) of containers shipped to the sampling facility. Trip blanks shall be returned unopened to the laboratory, and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage or site conditions. The trip blank shall be analyzed for VOC only, as shown on EPA's target compound list (TCL; see EPA 1991b).

In compliance with standard procurement procedures, requirements for trip blank preparation shall be included in procurement documents of work orders to the sample container supplier and/or preparer.

Unless otherwise specified in WHC-approved analytical methods, internal QC checks performed by analytical laboratories shall meet the following minimum requirements.

- Matrix-spike/matrix-spike duplicate samples. Matrix-spiked samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage and as a test of analytical precision. The spike shall be made in a replicate of a field duplicate sample. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the analytical procedures submitted for WHC review and approval. One sample shall be spiked per analytical batch, or once every 20 samples, whichever is more frequent.

- Quality control reference samples. A QC reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required as an independent check on analytical technique and methodology, and shall be run with every analytical batch, or every 20 samples, whichever is more frequent.

Other requirements specific to laboratory analytical equipment calibration are included in Section 6.0 of this QAPjP. For field screening gas chromatography (GC) analysis, at least one duplicate sample per shift shall be routed to a qualified laboratory as an overcheck on the proper use and functioning of field GC procedures and equipment. Duplicates shall be selected, whenever possible, from samples in which significant readings have been observed during field analysis. The minimum requirements of this section shall be invoked in procurement documents or work orders in compliance with standard procedures as noted in Section 4.1 of this QAPjP.

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance, system, and program audits are scheduled to begin early in the execution of the pilot-scale test program and continue through testing completion. Collectively the audits address quality affecting activities that include, but are not limited to, measurement system accuracy, intramural and extramural analytical laboratory services, field activities, and data collection, processing, validation, and management.

Performance audits of the accuracy of laboratory analysis are implemented in accordance with EII 1.12 Laboratory Analysis Performance Audits (WHC 1988a). System audit requirements are implemented in accordance with requirements of WHC (1988b). Surveillances will be performed regularly throughout the course of the work plan activities. Additional performance and system "surveillances" may be scheduled as a consequence of corrective action requirements, or may be performed upon request. All quality affecting activities are subject to surveillance.

All aspects of inter-operable unit activities will also be evaluated as part of routine environmental restoration program-wide QA audits under the Standard Operating Procedure requirements of WHC (1988b). Program audits shall be conducted in accordance with QR 18.0, Audits, QI 18.1, Audit Programming and Scheduling, and QI 18.2, Planning, Performing, Reporting, and Follow-up of Quality Audits by auditors qualified in accordance with QI 2.5, Qualification of Quality Assurance Personnel (WHC 1988b).

11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratories that directly affect the quality of the field and analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime and corresponding schedule delays. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment. Maintenance requirements, spare parts lists and instructions shall be included in individual laboratory QA plans, subject to review and approval as noted in Sections 2.1, 2.2, and 4.1.2 of this QAPjP. When samples are analyzed using EPA reference methods, the preventative maintenance requirements for laboratory analytical equipment are as defined in the procured laboratory's QA plan(s). Field equipment shall be drawn from inventories subject to standard preventive maintenance and calibration procedures as noted under criterion 12 of the QAPI included in WHC (1990b). Any field procedures submitted for WHC approval by participant contractors or subcontractors shall contain, as appropriate, provisions for preventive maintenance schedules and spare parts lists to ensure minimization of equipment downtime.

12.0 DATA ASSESSMENT PROCEDURES

All analytical data shall be compiled, reduced, and reviewed by the laboratory prior to presentation to HASM or subcontractor personnel for validation as described in Section 8.0 of this QAPjP. Depending on the distribution and statistical characteristics of the validated data and other unit- or area-specific considerations, various statistical and/or probabilistic

techniques may be selected for use in the process of data comparison or analysis. The selection of any such methodology shall be subject to the approval and authorization of the technical lead. Methods shall be documented, signed, dated, and retained as project records in compliance with Section 2.0 of WHC (1990a).

13.0 CORRECTIVE ACTION

13.1 GENERAL REQUIREMENTS FOR CORRECTIVE ACTION

Corrective action requests required as a result of surveillance reports, nonconformance reports, program audit activities, or as a result of the specific request of the operable unit manager, shall be documented and dispositioned by the technical lead and QA Coordinator as required by QR 16.0, Corrective Action (WHC 1988b). Corrective action reports prepared under QR 16.0 requirements shall identify the affected requirement, the probable cause of the deviation, any data which may have been affected by the deviation, and the corrective action required both to resolve the immediate situation and to reduce or preclude its recurrence. Corrections of plans or procedures related to the overall measurement system that do not constitute nonconformances, but may be required as a result of data validation, data assessment, or routine review processes, shall be resolved as required by their governing procedures or shall be referred to the technical lead for resolution and appropriate management action. All documentation related to surveillances, audits, and corrective action shall be maintained in compliance with EII 1.6, Records Processing (WHC 1988a) and routed to the project quality records upon completion or closure for retention in compliance with Section 9.0 of WHC (1990a), and shall be made available for operable unit manager review upon request through the technical lead.

13.2 CORRECTIVE ACTION REQUIREMENTS RELATED TO CALIBRATION ERRORS

Field measuring and test equipment found to be out of calibration shall be documented as a nonconformance in compliance with QR 15.0, Control of Nonconforming Items (WHC 1988b). Nonconforming items shall be tagged, removed from service, and segregated pending resolution of the nonconformance and initiation of appropriate corrective action in compliance with QR 16.0, Corrective Action (WHC 1988b). Calibration errors related to laboratory analytical processes that may be observed in the data validation activities described in Section 8.0 of this QAPjP shall prompt requests for reanalysis or other appropriate corrective action by the responsible laboratory as required by the governing HASM or approved subcontractor data validation procedures. If sample holding time requirements are compromised, insufficient sample material is available for reanalysis, or any other condition prevents compliance with governing analytical methods and data validation protocols, the situation shall be initiated in

compliance with the requirements of QR 16.0, Corrective Action (WHC 1988b) and brought to the attention of the technical lead and QA Coordinator for their appropriate action.

13.3 CORRECTIVE ACTION REQUIREMENTS RELATED TO PROCEDURAL DEVIATIONS

Planned deviations from EII requirements shall be processed in compliance with EII 1.4, Instruction Change Authorization (WHC 1988a). Unplanned procedural deviations observed during system audit, surveillance, or program audit activities shall be documented as nonconformances, findings, or observations in compliance with the procedures described in Section 10. Corrective action shall be initiated in compliance with QR 16.0, Corrective Action (WHC 1988b) as previously noted in Section 13.1 of this QAPjP.

13.4 CORRECTIVE ACTION REQUIREMENTS RELATED TO PURCHASED MATERIALS, ITEMS, OR EQUIPMENT

Purchased materials, items, and equipment found to be out of compliance with their governing procurement specifications shall be documented as a nonconformance in compliance with QR 15.0, Control of Nonconforming Items (WHC 1988b). Nonconforming items shall be tagged and segregated pending resolution of the nonconformance and initiation of appropriate corrective action in compliance with QR 16.0, Corrective Action (WHC 1988b).

14.0 QUALITY ASSURANCE REPORTS

As previously stated in Sections 10.0 and 13.0 of this QAPjP, project activities shall be regularly assessed by performance and system audits, surveillances, and program audits. Surveillance, nonconformance, audit and corrective action documentation shall be routed to the project quality records on completion or closure of the activity. A report summarizing corrective action shall be prepared for the technical lead by QA at the completion of the field and laboratory investigations. The pilot-scale test report shall include an assessment of the overall adequacy of the total measurement system with regard to the DQOs of the investigation.

15.0 REFERENCES

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WHC, 1990a, *Document Control and Records Management Manual*, WHC-CM-3-5, Westinghouse Hanford Company, Richland, Washington.

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WHC, 1990d, *Sample Management and Administration Manual*, WHC-CM-5-3, Westinghouse Hanford Company, Richland, Washington.